US 20130149089A1

(19) **United States**

(12) **Patent Application Publication**

Harms, JR. et al.

(10) **Pub. No.: US 2013/0149089 A1**

(43) **Pub. Date: Jun. 13, 2013**

(54) **SYSTEMS AND DEVICES FOR REMOVING MATERIALS FROM VACUUM TRUCK TANKS**

(75) Inventors: **Gary W. Harms, JR.**, Fort Morgan, CO (US); **William David Rollins**, Calgary (CA); **Jennifer Orom**, Bashaw (CA)

(73) Assignee: **PRO-TECH ENTERPRISES, LLC**, Fort Morgan, CO (US)

(21) Appl. No.: **13/323,580**

(22) Filed: **Dec. 12, 2011**

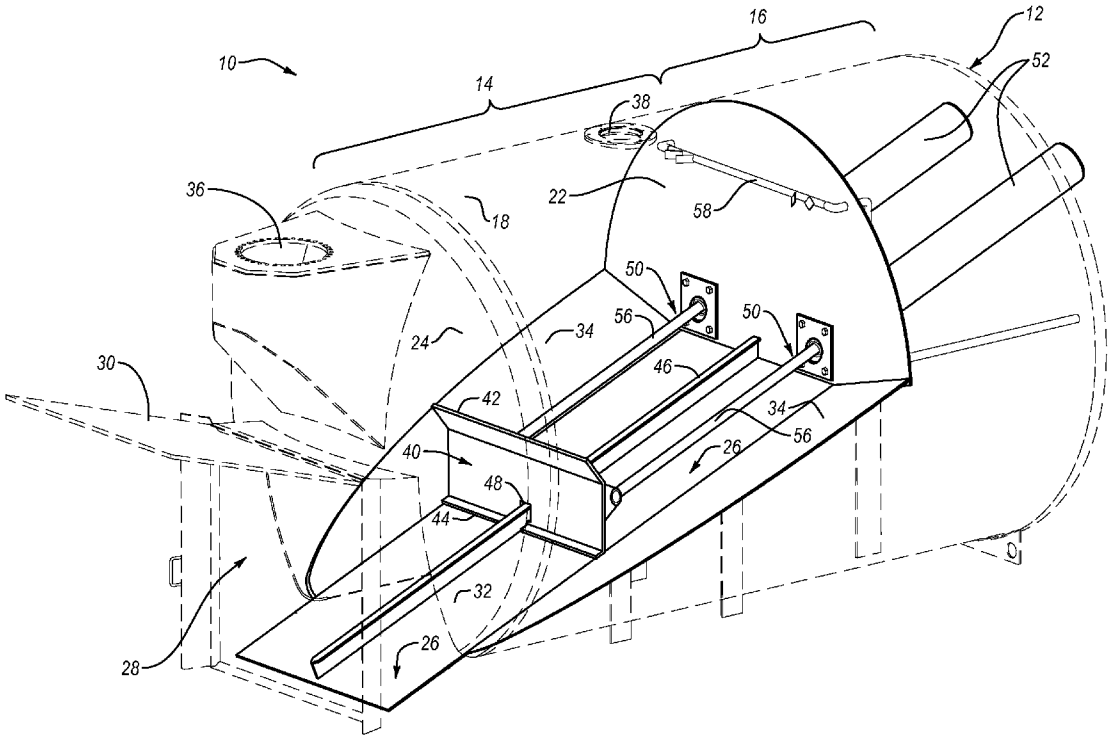
Publication Classification

(51) **Int. Cl.**
B60P 3/16 (2006.01)

(52) **U.S. Cl.**
USPC **414/513**

(57) **ABSTRACT**

Systems and devices for removing materials from vacuum truck tanks are disclosed herein. An exemplary system for removing materials from a vacuum truck may include a tank having one or more walls enclosing the tank and an opening in the one or more walls to facilitate removal of materials from the tank; a blade positioned within the tank and configured to push materials towards the opening to remove or discharge collected materials from the tank; and a drive mechanism configured to selectively move the blade towards the opening in the tank. Additional systems and devices for removing materials from vacuum truck tanks are also disclosed herein.



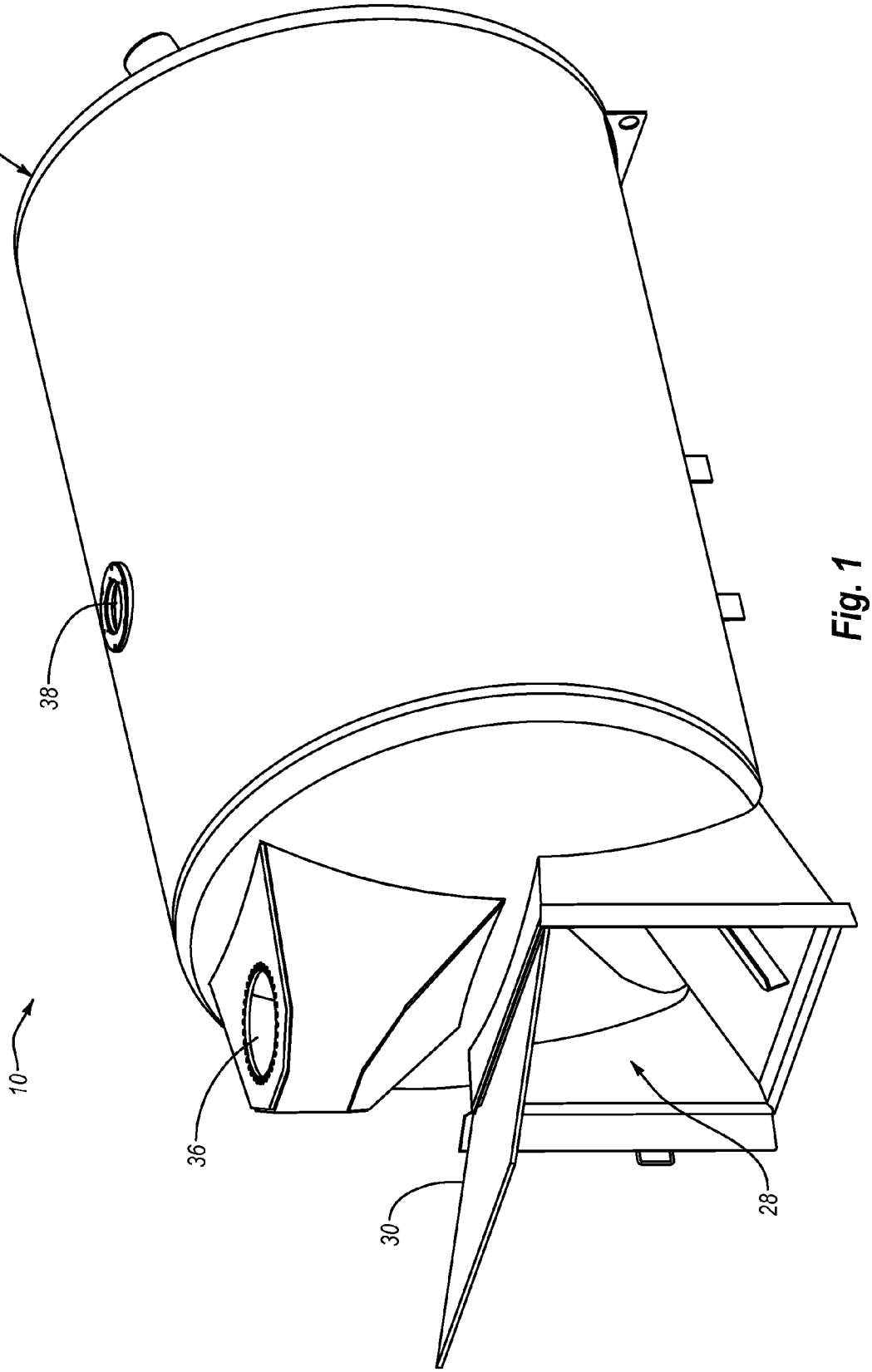


Fig. 1

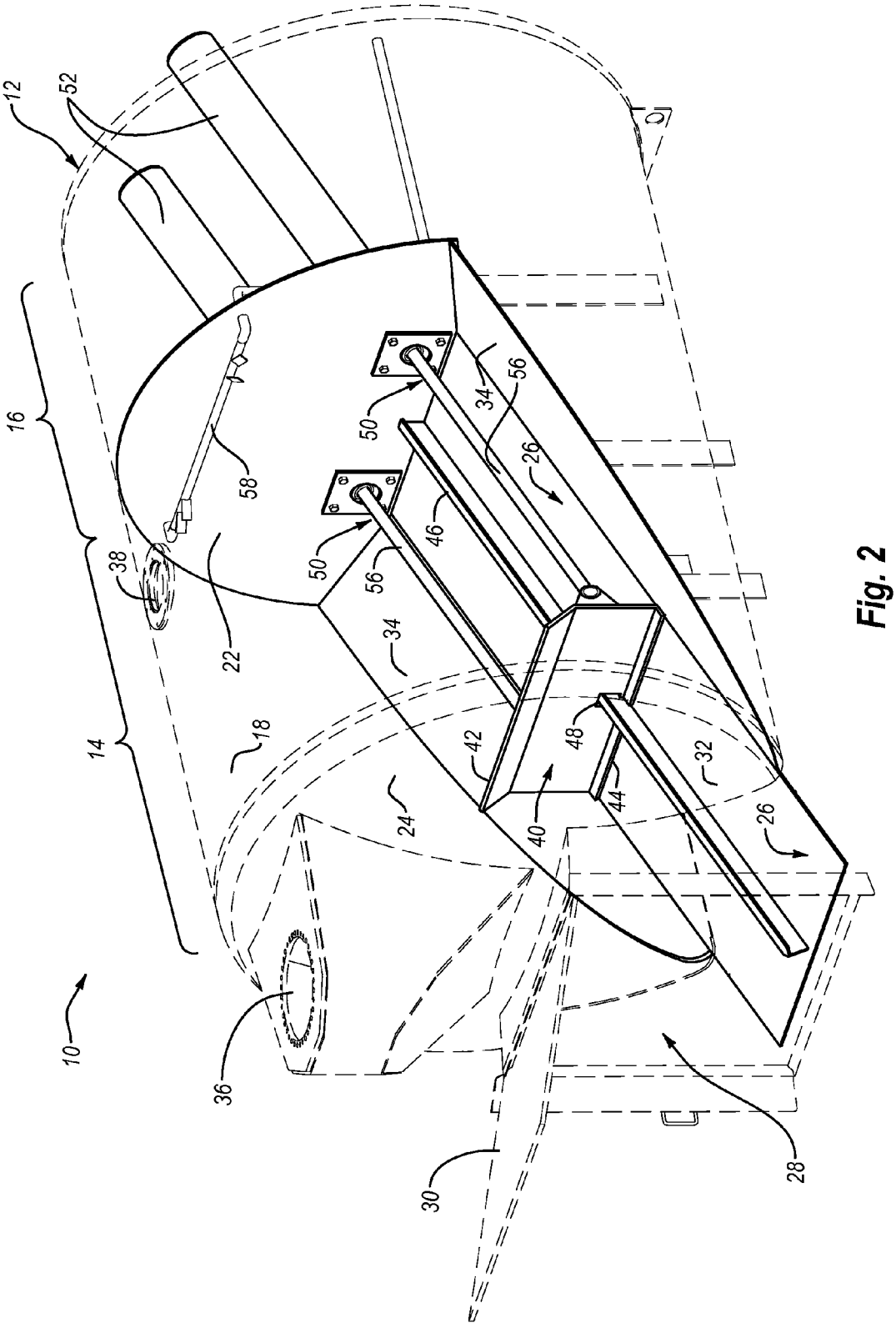


Fig. 2

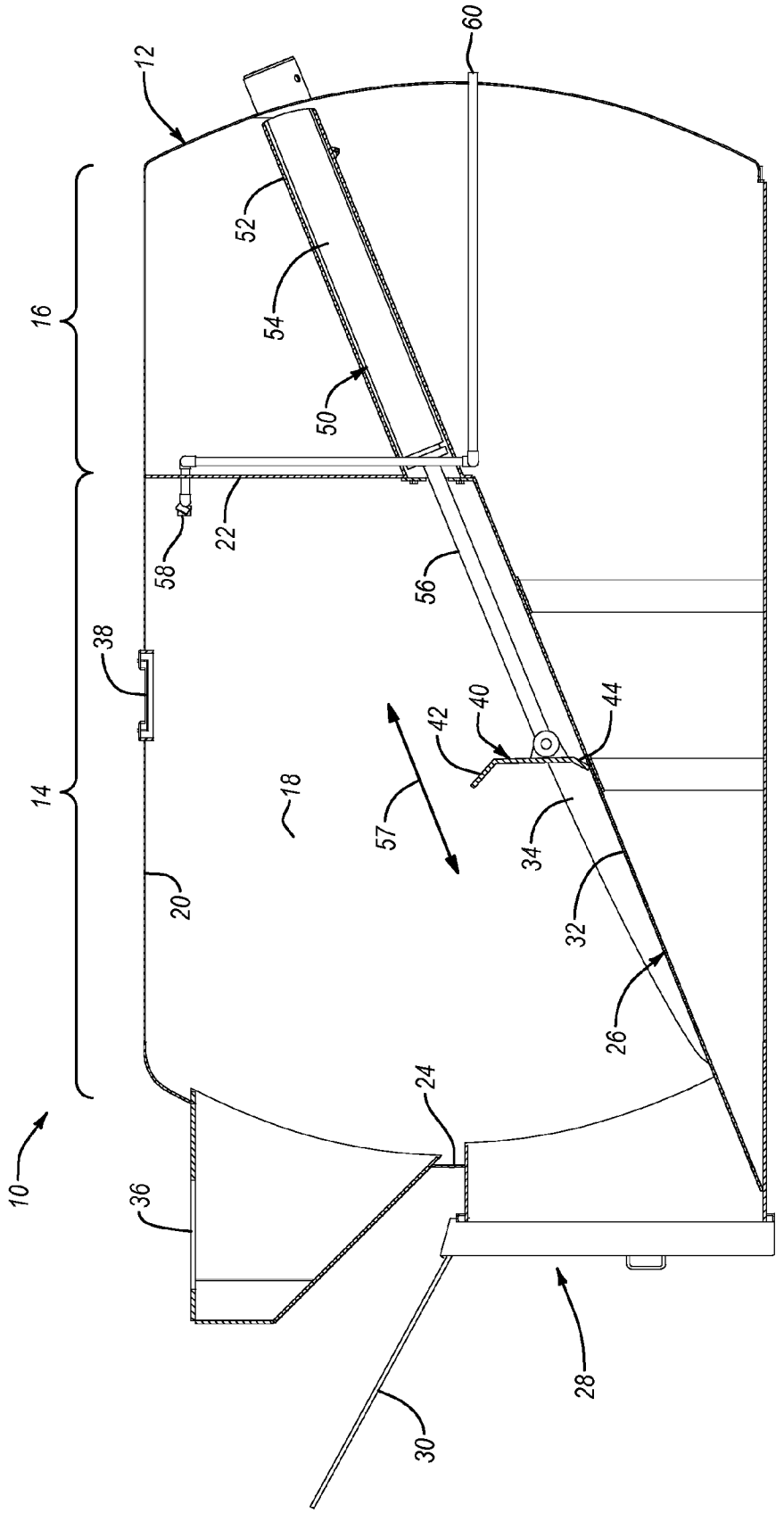

10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
50
52
54
56
57
58
60

Fig. 3

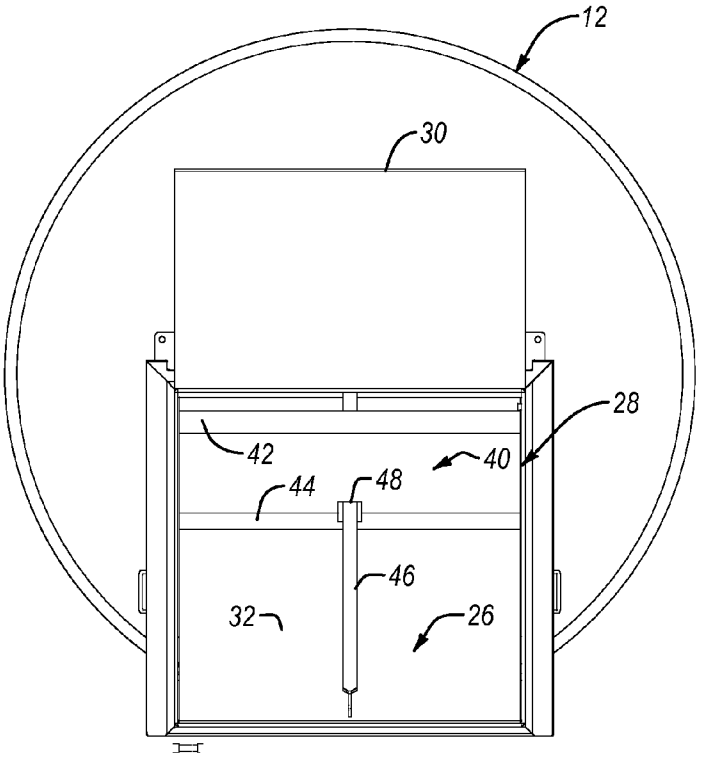

12
30
28
42
40
44
48
46
32
26

Fig. 4

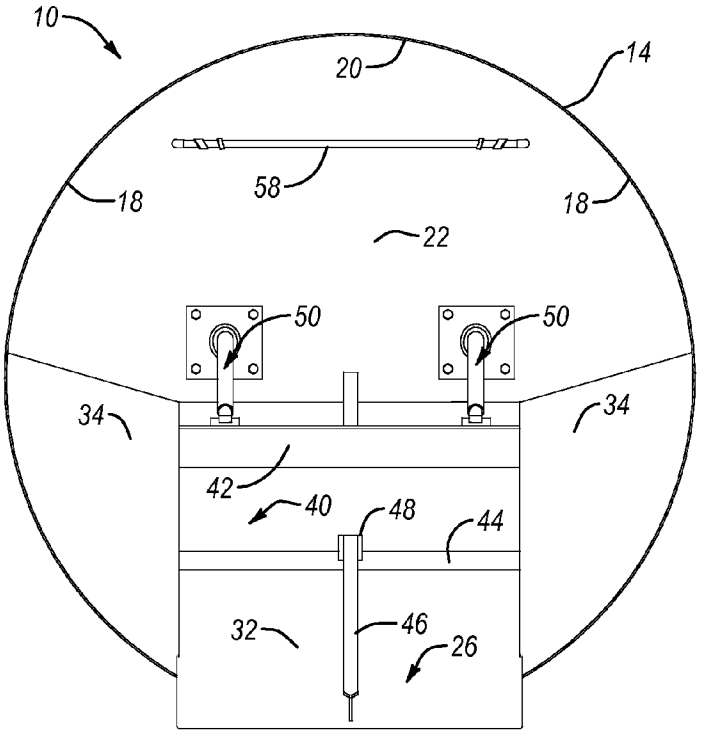

10
20
14
58
18
18
22
50
50
34
34
42
40
48
44
32
46
26

Fig. 5

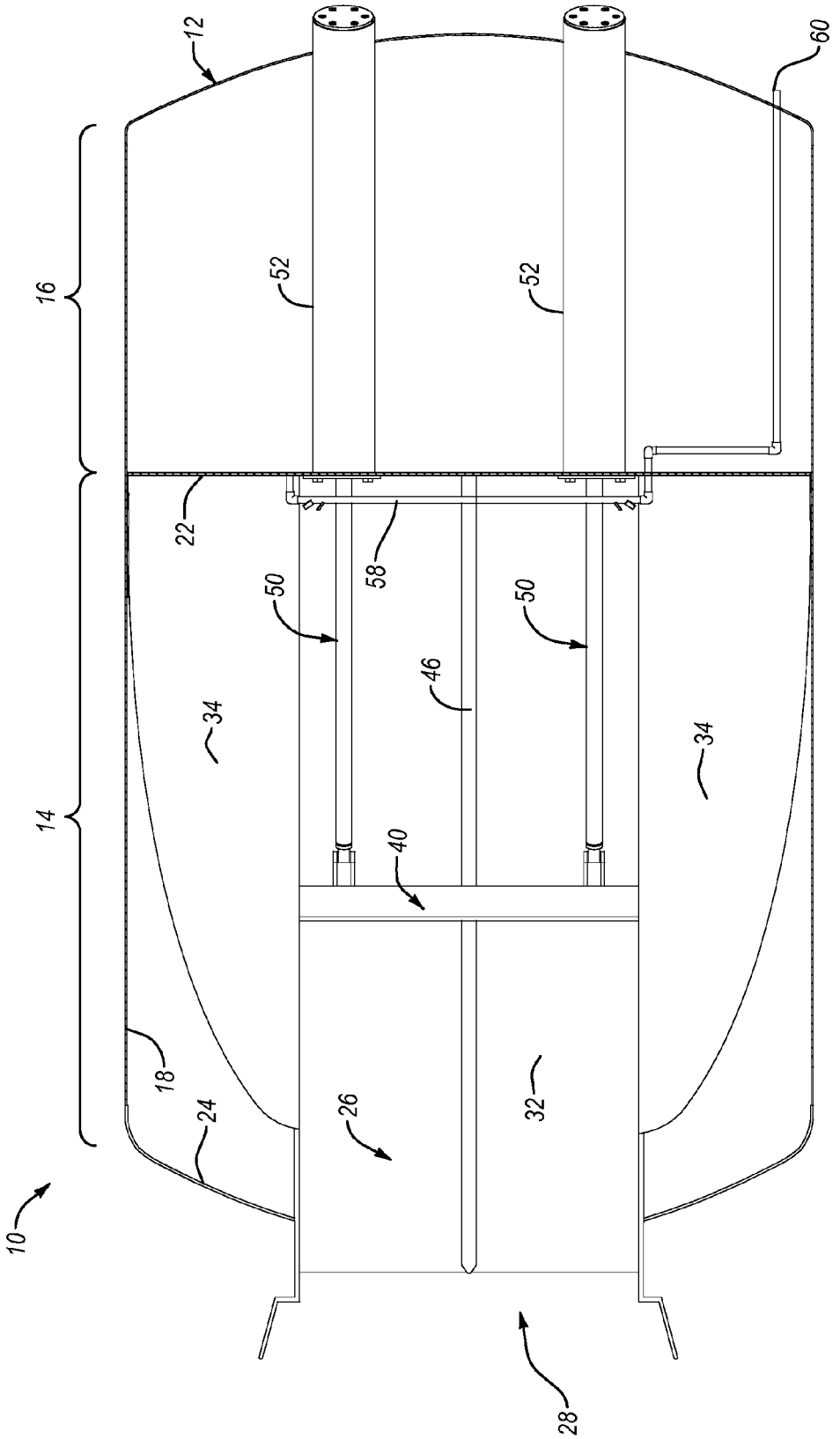


Fig. 6

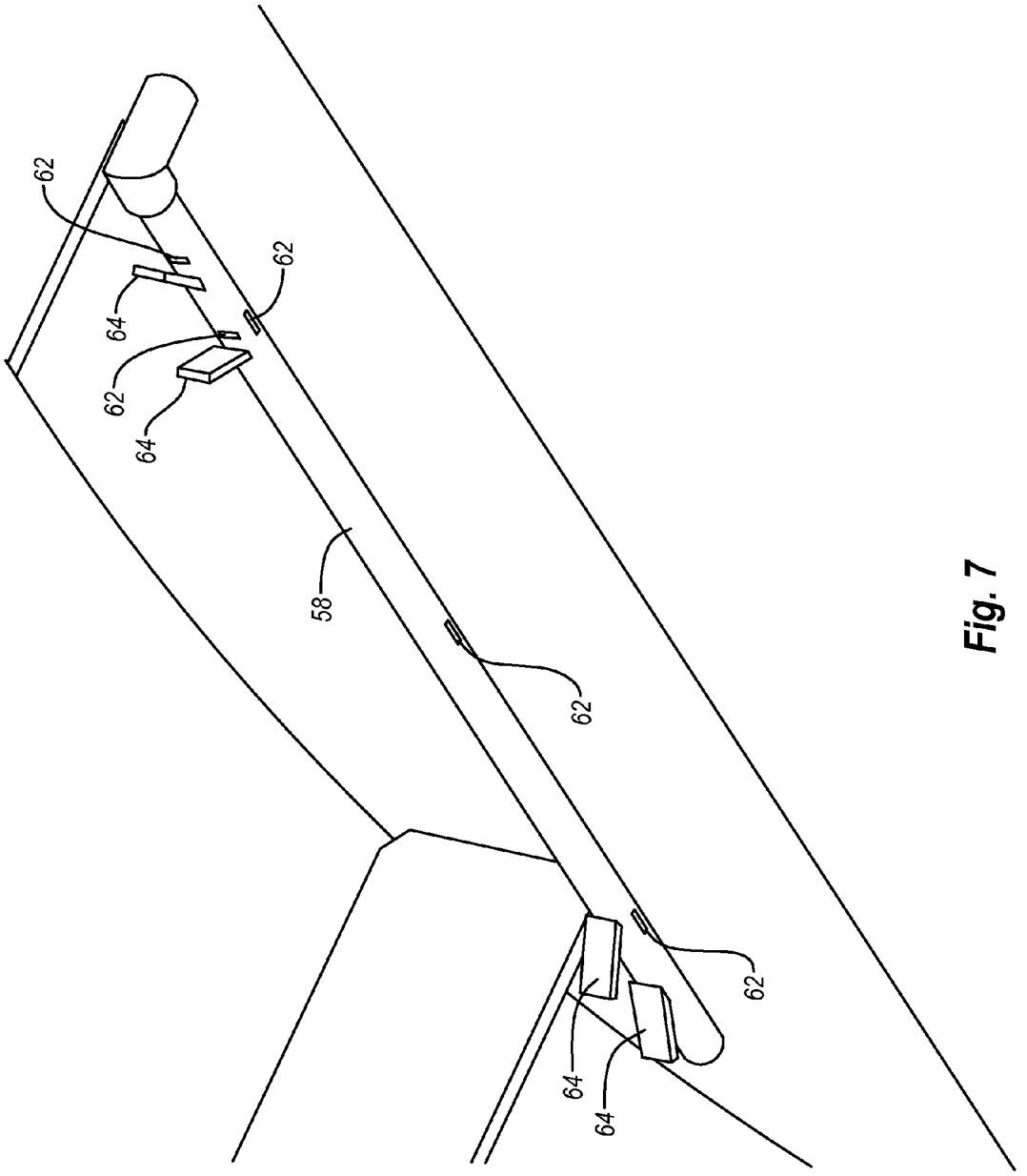


Fig. 7

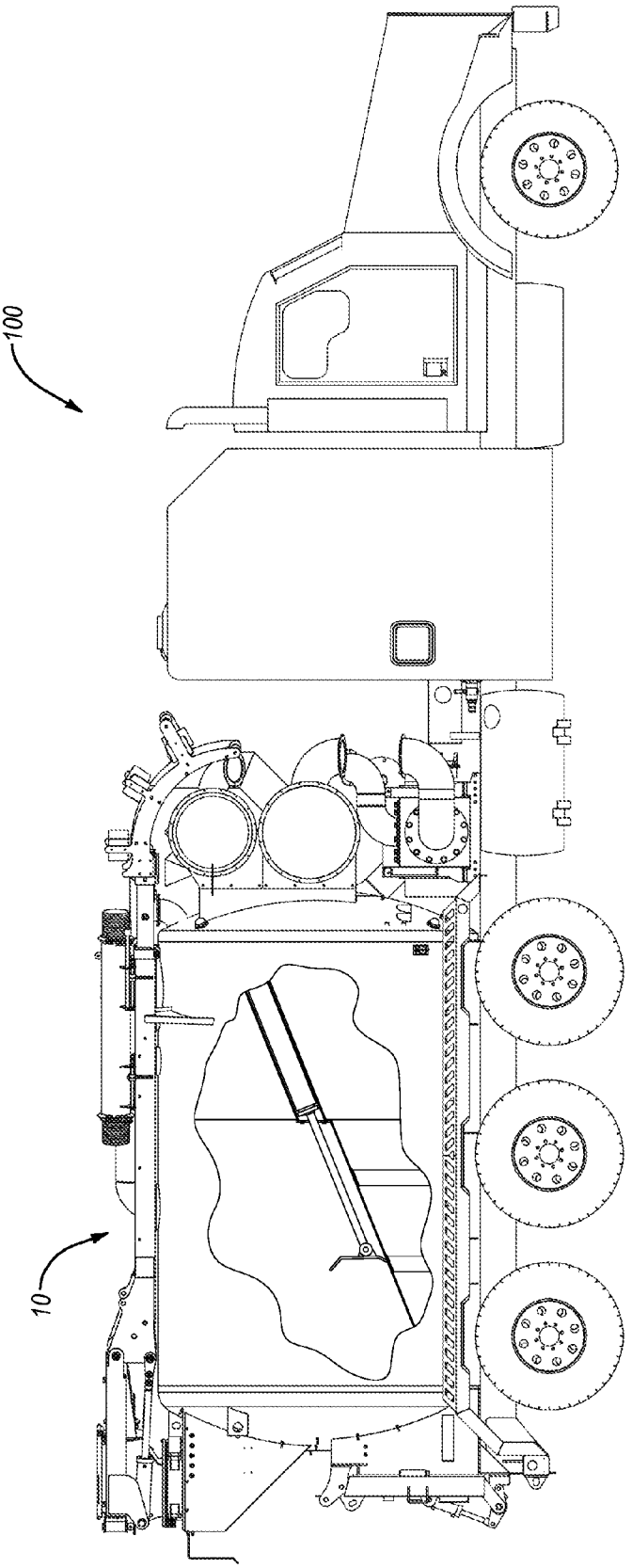


Fig. 8

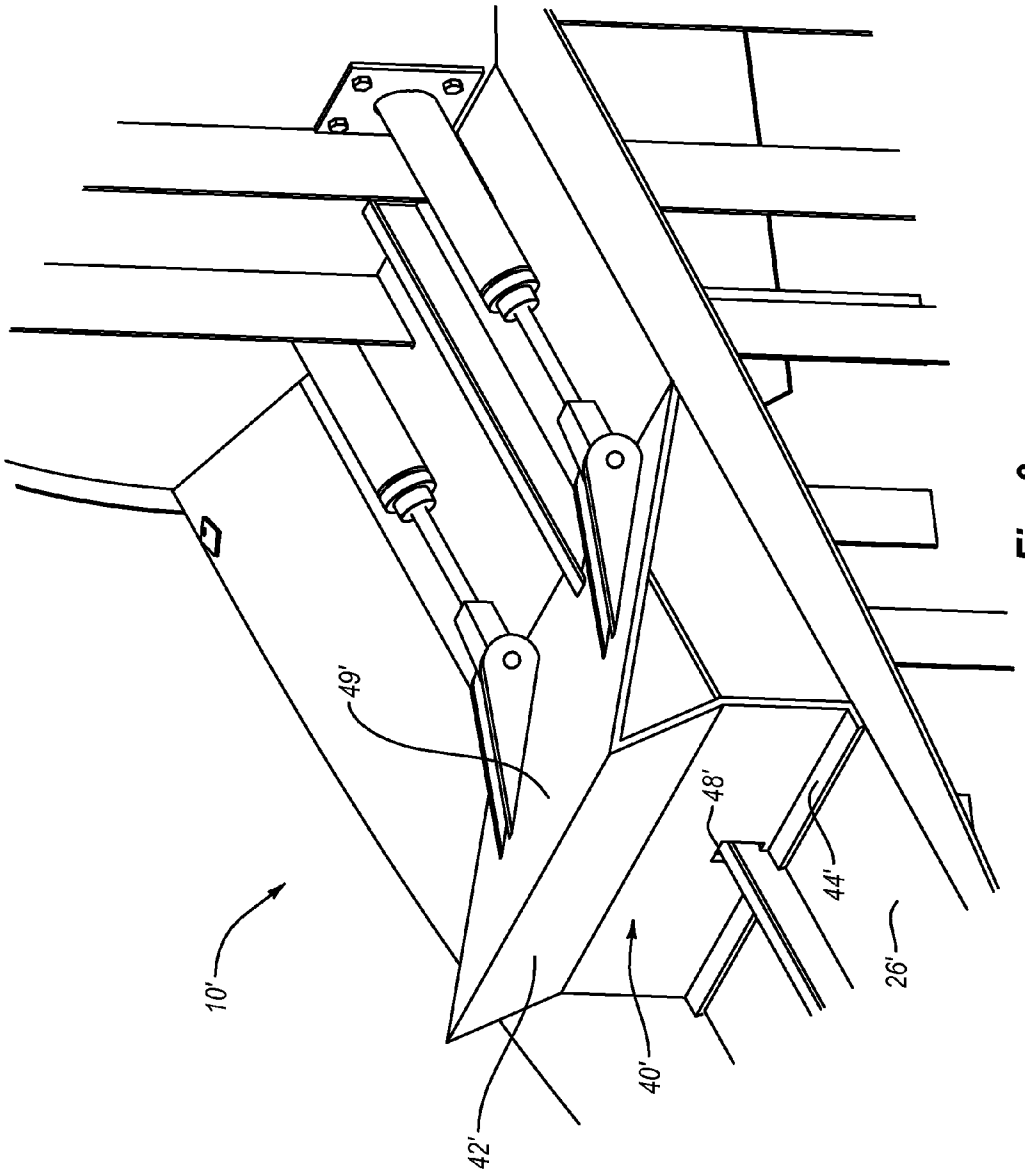


Fig. 9

SYSTEMS AND DEVICES FOR REMOVING MATERIALS FROM VACUUM TRUCK TANKS

BACKGROUND OF THE INVENTION

[0001] Vacuum trucks are truck-mounted heavy duty industrial vacuum loaders designed to pneumatically convey solids, liquids, sludge, slurry, or other materials through suction hoses into a collection tank. Vacuum trucks are utilized in a variety of industries (e.g., drilling, exploration, excavation, sewage collection, hazardous waste collection, refuse collection, etc.) for collecting a variety of materials. In addition to being useful in the collection of materials, vacuum trucks can also be used to transport the collected materials to another site for processing or disposal.

[0002] As a specific example, in drilling operations, a fluid commonly referred to as "mud" is circulated from the surface, downward through a drill pipe and out openings in the drill bit at the bottom of a borehole. After exiting the drill bit at the bottom of the borehole, the mud along with other material from the borehole (often referred to collectively as "cuttings"), are pushed back upward through the borehole to the surface. Once at the surface, the cuttings that are extracted from the borehole may be processed in order to separate the mud from the other material. The mud may then be recycled and sent back down the drill pipe, and the material that is separated from the mud may be collected into a separate area or container. The material that is separated from the mud, which is commonly referred to as "sludge," may include a mixture of different solids, such as stone, dirt, clay, and salt. It is also common for sludge to include nonsolid components, such as water, oil, mud, and other fluids. Vacuum trucks can be very useful to collect, process, and/or transport the drilling mud and sludge. In particular, an operator can utilize the vacuum truck to suction the materials into a collection tank (often referred to as a "mud tank"), after which the vacuum truck can transport the collected materials to a different location for disposal or processing.

[0003] However, there are a number of disadvantages associated with conventional vacuum trucks and systems. As evident from the process above, the tank of the vacuum truck must be periodically emptied. According to conventional systems, removal of the materials from the tank is done by using hoists or other mechanisms to lift or tip the tank and dump the collected materials out of the tank. These systems result in an inefficient use of energy and time. In particular, the additional power and time needed to lift the entire tank to remove the collected materials results in additional expenses in the form of fuel and man-hours. Furthermore, the mechanisms necessary to lift the tank are complex and result in an increased manufacturing, purchase, and maintenance costs.

[0004] In addition, these conventional systems are often ineffective. For example, the vibrations of the vacuum trucks during travel or operation may compact collected materials within the tank, thereby causing the materials to adhere together and to the inner surfaces of the tank. As a result, merely lifting or tipping the tank may be insufficient to remove the materials from the tank. To remedy this, operators of the vacuum trucks may be forced to physically enter the tanks to manually remove or assist in removing the materials. This is an ineffective, inefficient, and unsafe system and method of removing materials from a vacuum tank. Forcing the operators to enter the tanks and manually remove the materials puts the operators in a dangerous situation that could result in injury from accident or overexertion. In addition, the moving parts necessary to lift or tip the tank create additional pinch points, not to mention instability, that can cause injury to those working on or nearby the vacuum truck.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The accompanying drawings illustrate various embodiments and are a part of the specification. The illustrated embodiments are merely examples and do not limit the scope of the disclosure. Throughout the drawings, identical or similar reference numbers designate identical or similar elements.

[0006] FIG. **1** illustrates a perspective view of an exemplary system for removing materials from vacuum truck tanks, according to the principles described herein.

[0007] FIG. **2** illustrates a perspective view of various internal components of the exemplary system of FIG. **1**, according to principles described herein.

[0008] FIG. **3** illustrates a side, partial cut away view of the exemplary system of FIG. **1**, according to principles described herein.

[0009] FIG. **4** illustrates an end view of the exemplary system of FIG. **1**, according to principles described herein.

[0010] FIG. **5** illustrates an end view of various internal components of the exemplary system of FIG. **1**, according to principles described herein.

[0011] FIG. **6** illustrates a top view of various internal components of the exemplary system of FIG. **1**, according to principles described herein.

[0012] FIG. **7** illustrates a spray bar of the exemplary system of FIG. **1**, according to principles described herein.

[0013] FIG. **8** illustrates an exemplary vacuum truck, according to principles described herein.

[0014] FIG. **9** illustrates a perspective view of various internal components of another exemplary system for removing materials from vacuum truck tanks, according to the principles described herein.

DETAILED DESCRIPTION

[0015] Exemplary systems and devices for removing materials from vacuum truck tanks are disclosed herein. As will be described in more detail below, in certain implementations, the systems and devices disclosed herein may be configured to allow a vacuum truck operator to efficiently, effectively, and safely remove collected materials from a tank of a vacuum truck. For example, the systems and devices disclosed herein may be configured to allow a vacuum truck operator to effectively remove collected materials from a vacuum truck's tank without the need for a mechanism to lift or tip the tank. In addition, the systems and devices disclosed herein may be configured to reduce or remove the need for manual intervention and physical labor to remove the materials from the vacuum truck's tank. Additional benefits and/or advantages will be apparent from the details disclosed herein.

[0016] As used herein, the term "vacuum truck" may be used to refer to any mobilized industrial vacuum loader including, but not limited to, wet and dry vacuum trucks, liquid-only vacuum trucks, hydro-excavation vacuum trucks ("hydrovac trucks"), sewage vacuum trucks, industrial air mover trucks, vacuum trailers, street cleaners, or any other suitable vacuum truck. Vacuum trucks may have varying sizes, capacities, and functions. Vacuum trucks may include structures and mechanisms to facilitate the process of pneumatically loading materials into the vacuum trucks. For

example, vacuum trucks may include blowers, pumps, tanks, separators, filters, traps, silencers, boom lines, pipes, hoses, and/or any other suitable features configured to allow the vacuum truck to pneumatically collect waste materials. In some examples, one or more mechanisms (e.g., blowers or pumps) may be powered by one or more power take offs operably connected to a vacuum truck's engine.

[0017] Vacuum trucks may be used to collect a variety of waste materials in various forms. Waste materials may include wet materials, dry materials, liquids, solids, any other suitable materials, or combinations thereof. By way of example and not limitation, waste materials may include stone, dirt, debris, clay, salt, water, oil, dust, mud, sludge, slurry, hazardous waste, chemicals, sewage, etc.

[0018] Various principles disclosed herein are provided with relation to and within the context of a hydrovac truck. However, one will appreciate that the principles disclosed herein can be applied to any other suitable vacuum truck.

[0019] FIGS. **1** through **7** illustrate an exemplary system **10** for removing materials from a vacuum truck tank. In particular, FIG. **1** illustrates a perspective view of the exterior of system **10**; FIG. **2** illustrates a perspective view of the interior of system **10** with the exterior represented by dashed lines; FIG. **3** illustrates a side cut-away view of system **10**; FIG. **4** illustrates an end view of the exterior of system **10**; FIG. **5** illustrates an end view of the interior of system **10**; FIG. **6** illustrates a top view of the interior of system **10**; and FIG. **7** illustrates a close-up view of a spray bar of system **10**.

[0020] As shown in FIG. **1**, system **10** may include a generally cylindrical tank system **12** (or simply "tank **12**") that may be mounted to the frame of a vacuum truck. Tank **12** may be configured to house, define, and/or include one or more additional components of system **10**. In some examples, tank **12** may include or be subdivided into multiple tanks. For example, as shown in FIGS. **2** and **3**, tank **12** may include a mud tank **14** configured to temporarily store collected waste materials (e.g., by way of a suction hose, boom line, etc.) and a water tank **16** configured to temporarily store water (e.g., water recycled from materials collected within mud tank **14**). Like tank **12**, mud tank **14** and/or water tank **16** may be at least partially cylindrical in configuration. For example, tank **12** may define one or more walls of mud tank **14** and/or water tank **16**. In additional or alternative examples, tank **12**, mud tank **14**, and/or water tank **16** may have any other suitable shapes and/or configurations. For example, tank **12**, mud tank **14**, and/or water tank **16** may have a generally rectangular shape.

[0021] Mud tank **14** may include one or more enclosing structures defining the walls, roof, and/or floor of mud tank **14**. For example, as shown in FIGS. **2** and **3**, mud tank **14** may include one or more side walls **18**, a roof **20**, a back wall **22** (e.g., bordering and/or separating mud tank **14** from water tank **16**), an end wall **24** (e.g., at an end of system **10**) and a floor **26** that define mud tank **14**, enclose mud tank **14**, and/or separate mud tank **14** from water tank **16**. In some examples mud tank **14** may be supported and/or partially suspended within tank **12** and/or water tank **16** by one or more braces located within water tank **16**. For example, floor **26** and/or back wall **22** may be suspended above the bottom of water tank **16** and supported by one or more braces.

[0022] Mud tank **14** may additionally or alternatively include an opening **28** to facilitate removal of materials from mud tank **14**. For example, opening **28** may be in one or more of side walls **18**, roof **20**, back wall **22**, end wall **24**, and floor **26**. To illustrate, as shown in FIGS. **1**, **2**, and **3**, opening **28** may be located within and proximate the base of end wall **24** (e.g., such that opening **28** is positioned near the rear of system **10** or a corresponding vacuum truck). In additional or alternative examples, opening **28** may be located at any other suitable position and/or as part of any other suitable structure (s) of mud tank **14**. For example, opening may be located within floor **26** and/or side walls **18**.

[0023] In some examples, a removable cover **30** may be mounted on mud tank **14** over the opening **28**. Removable cover **30** may be configured to provide an air-tight seal over opening **28** to facilitate vacuuming operations and to selectively open to facilitate removal of any collected materials from mud tank **14**. Accordingly, an operator may open removable cover **30** in order to access mud tank **14** and/or remove materials collected within mud tank **14**. Removable cover **30** may be configured to be opened in any suitable manner (e.g., manually, mechanically, etc.). In some examples, system **10** may include a lift mechanism configured to assist the operator in opening and/or closing removable cover **30**.

[0024] As mentioned above, mud tank **14** may include a floor **26** that extends between and/or is connected to side walls **18**, back wall **22**, and/or end wall **24**. In some examples, as shown in FIGS. **2** and **3**, floor **26** may slope in one or more directions. For example, floor **26** may be configured to slope towards opening **28** to utilize the natural effects of gravity to assist in the removal of materials from mud tank **14** through opening **28**, without the need to physically lift or tip mud tank **14**. To illustrate, as shown in FIGS. **2** and **3**, floor **26** slopes downward as it extends from back wall **22** towards end wall **24** and opening **28**. The angle of slope of floor **26** may be specifically tailored for a particular implementation (e.g., for a particular type of vacuum truck and/or materials). In some examples, the angle of the slope of floor **26** may be within the ranges of 5 to 60 degrees, 15 to 50 degrees, and/or 25 to 45 degrees.

[0025] Floor **26** may have any suitable shape, size, and/or configuration. In some examples, floor **26** may include a single piece (e.g., a single steel plate) that extends between side walls **18**, back wall **22**, and end wall **24**. In additional or alternative embodiments, floor **26** may have one or more distinct, connected sections. For example, as shown in FIGS. **2**, **5**, and **6**, floor **26** may include a central section **32** defining a central portion of floor **26** extending from back wall **22** to end wall **24** and opening **28**. Floor **26** may also include one or more side sections **34** that define the sides of the floor **26** and extend outwards from central section **32** to side walls **18**.

[0026] In some examples, as shown in FIGS. **2** and **5**, side sections **34** may slope downward from side walls **18** towards central section **32**. As a result, side sections **34** may direct collected materials within mud tank **14** towards central section **32** in order to facilitate the removal of the materials from mud tank **14**. Side sections **34** may have any suitable slope, as may be desirable for a particular implementation. For example, a manufacturer of system **10** may select the slope of side sections **34** to suit a particular use for system **10** and/or in accordance with a particular type of waste materials that will be collected by system **10**. In some examples, the angles of slope of side sections **34** relative to central section **32** may be within the range of 5 to 45 degrees.

[0027] Although central section **32** and side sections **34** are shown in the Figures as being generally flat pieces, one will appreciate that sections **32** and **34** may have any other suitable size, shape, and/or configuration whether regular or irregular.

Similarly, floor **26** may have any suitable regular or irregular shape, size, and configuration. For example only, rather than including primarily flat surfaces, in additional or alternative embodiments, floor **26** may include one or more curved or stepped surfaces.

[0028] In addition to opening **28**, mud tank **14** may also include other openings to facilitate vacuuming operations performed with system **10**. For example, mud tank **14** may include an entrance port **36** for receiving materials into the mud tank **14** (e.g., by way of a suction hose and/or boom line). In addition, mud tank **14** and water tank **16** may be in fluid communication with each other by way of one or more pipes to facilitate the passage of air and/or water from mud tank **14** into water tank **16**. For example, air and other vapors may be suctioned out of the mud tank **14** through an outlet port **38** and into water tank **16**. Additionally or alternatively, the air and vapors may be suctioned through one or more filters, silencers, and/or separators prior to or after entering water tank **16**. Mud tank **14** and/or water tank **16** may include any other suitable features or structures to facilitate the collection, storage, processing, and/or transportation of waste materials.

[0029] As mentioned above, system **10** may include one or more features to assist in removing collected materials from mud tank **14**. For example, as shown in FIGS. **2**, **3**, **5**, and **6**, system **10** may include one or more devices, mechanisms, and/or structures for pushing, sweeping, or otherwise discharging collected materials out of the mud tank **14** and/or through opening **28**. To illustrate, system **10** may include a paddle or blade **40** configured to move along the length of floor **26** to push or sweep materials collected within the mud tank **14** towards and/or through opening **28**. Blade **40** may be configured to facilitate the most efficient removal of materials from mud tank **14**. For example, blade **40** may be specifically configured to maximize the amount of materials that blade **40** is capable of moving and/or to otherwise facilitate the efficient removal of materials from mud tank **14**. In some examples, blade **40** may have a concave shape and/or may include one or more angled flanges along the top, bottom, and/or sides of blade **40**. To illustrate, as shown in FIGS. **2** and **3**, blade **40** may include an upper flange **42** and a lower flange **44** angled towards opening **28** to increase the capacity of blade **40** and/or the ability of blade **40** to remove materials from the surface of floor **26**. The angles of flanges **42** and **44** relative to the face of blade **40** may be configured as desired for a particular implementation. For example, in some embodiments, flanges **42** and **44** may each have an angle between 20 and 90 degrees with respect to the face of blade **40**. In some examples, lower flange **44** may be angled so as to sit flush against the surface of floor **26**. In additional or alternative embodiments, blade **40** may have any other suitable configuration, such as an "S blade" configuration, a "U blade" configuration, an "S-U" configuration, and/or any other suitable blade configuration as may be desirable for a particular implementation.

[0030] In some examples, blade **40** may be configured so that the bottom edge of blade **40** sits flush against floor **26**, such that blade **40** may effectively scrape or dislodge collected materials from the surface of floor **26**. For example, the configuration of the bottom edge of blade **40** may correspond to the configuration of the surface of floor **26**. To illustrate, blade **40** may have a flat bottom edge to correspond to and interface with the generally flat surface of central section **32**. Additionally or alternatively, blade **40** may have a width generally equal to or slightly narrower than the width of central section **32** to ensure that blade **40** can seat properly against the surface of central section **32**. In some examples, blade **40** may also be narrow enough to at least partially fit into or through opening **28**.

[0031] System **10** may additionally or alternatively include one or more structures or features to guide the movement of blade **40** along floor **26**. For example, system **10** may include one or more guide rails **46** extending along the length of floor **26** and configured to guide the movement of blade **40** back and forth along floor **26**. Additionally or alternatively, blade **40** may include a guide slot **48** configured to receive guide rail **46** such that relative movement of blade **40** is at least partially restricted in at least one direction by the interaction between guide rail **46** and guide slot **48**. Guide rail **46** can have any suitable shape, size, and/or configuration. In turn, guide slot **48** may have a corresponding shape, size, and/or configuration. For illustrative purposes only, as shown in FIGS. **2**, **4**, and **5**, guide rail **46** may have a generally T-shaped cross-section, and guide slot **48** may also be T-shaped. In some examples, the resulting interaction between guide rail **46** and guide slot **48** may restrict movement of blade **40** along multiple directional axes. For example, the interaction between guide rail **46** and guide slot **48** may allow blade **40** to move back and forth along the length of floor **26** while preventing blade **40** from moving sideways, up, or down relative to floor **26**. As a result, the position of the blade **40** relative to and/or against the surface of floor **26** may be secured and/or maintained throughout the full range of movement of blade **40**. System **10** may include any additional or alternative features and/or structures for guiding and/or restricting the movement of blade **40**.

[0032] System **10** may include one or more drive mechanisms configured to move blade **40** back and forth along floor **26** in order to selectively push or sweep collected materials through opening **28** and out of mud tank **14**. For example, as shown in FIGS. **2**, **3**, **5**, and **6**, system **10** may include one or more hydraulic cylinders **50** connected to blade **40** and configured to selectively move blade **40** back and forth along floor **26**. Hydraulic cylinders **50** may connect to blade **40** at one end and may connect to tank **12**, water tank **16**, or some other fixed structure of system **10** at the other end. In some examples, the connection between hydraulic cylinders **50** and blade **40** may be a fixed connection that does not allow movement (e.g., rotation) of blade **40** relative to hydraulic cylinders **50**, to provide sufficient rigidity and strength to blade **40**.

[0033] Hydraulic cylinders **50** may extend at least partially out of mud tank **14**. For example, hydraulic cylinders **50** may extend at least partially into and/or through water tank **16**. In some examples, hydraulic cylinders **50** may extend through a back wall of water tank **16**, as shown in FIGS. **3** and **6**. In additional or alternative examples, hydraulic cylinders **50** may be positioned within system **10** and/or connected to other components of system **10** in any other suitable manner, as may serve a particular implementation.

[0034] As shown in FIG. **3**, hydraulic cylinders **50** may be at least partially housed within and/or protected by hydraulic cylinder housings **52** (or simply "housings **52**"). In some examples, housings **52** may be tubular and house the portions of hydraulic cylinders **50** that extend outside of mud tank **14**. To illustrate, as shown in FIG. **3**, a "barrel" or "body" **54** of each hydraulic cylinder **50** may be housed and/or fixedly connected within a corresponding housing **52**, while a piston rod **56** of each hydraulic cylinder **50** may extend from housing **52** into mud tank **14** to connect to blade **40**. Housings **52**

and/or the point of entry of piston rods **56** into mud tank **14** may include an air-tight seal so as not to deteriorate any suction forces within mud tank **14**. In additional or alternative embodiments, bodies **54** of hydraulic cylinders **50** may extend at least partially into mud tank **14**. In additional or alternative embodiments, housings **52** may provide a point of access to hydraulic cylinders **50** located outside of tank **12**. For example, at the ends opposite mud tank **14**, housings **52** may have removable plates through which an operator or mechanic may access hydraulic cylinders **50** without having to physically enter tank **12**, mud tank **14**, or water tank **16**.

[0035] Hydraulic cylinders **50** may be operably connected to one or more corresponding hydraulic pumps that may be selectively actuated to extend and/or retract piston rods **56** and blade **40**. Accordingly, an operator may utilize a control panel, one or more levers, or any other suitable control device to selectively actuate hydraulic cylinders **50** to effectuate movement of blade **40** back and forth along floor **26** in the direction indicated by arrows **57** shown in FIG. **2** and along a path that is generally parallel with hydraulic cylinders **50**. By so doing, the operator may safely and efficiently push materials collected within mud tank **14** out of opening **28**, without the need to lift mud tank **14** or manually remove the collected materials.

[0036] In some examples, the actuation of blade **40** may be at least partially automated. For example, system **10** may include one or more sensors in communication with a control panel and configured to sense the presence of materials within mud tank and/or the absence of any human operators within mud tank. In response to signals from the sensors indicating that materials remain in mud tank **14** and there are no safety hazards (e.g., there are no operators in or near mud tank **14**), system **10** may automatically actuate blade **40** to discharge the sensed materials from mud tank **14**. Similarly, system **10** may include one or more sensors configured to automatically disable the actuation of blade **40** in response to a detected mechanical failure or safety hazard. In additional or alternative embodiments, a control panel associated with system **10** may be remotely located relative to mud tank **14** and allow an operator to control blade **40** from a remote and safe location.

[0037] The specifications of hydraulic cylinders **50**, including the bore size, stroke length, rod diameter, max load, etc., may be specifically tailored or selected as desired for a particular implementation. In some examples, the stroke length of hydraulic cylinders **50** may be selected to achieve the greatest range of motion of blade **40** and/or to allow blade **40** to extend to a position close to or at least partially through opening **28**.

[0038] In additional or alternative embodiments, system **10** may include any other suitable drive mechanism for actuating blade **40**. For example, system **10** may include a belt drive mechanism, a chain drive mechanism, a screw drive mechanism, and/or any other suitable drive mechanisms capable of moving blade **40** back and forth along floor **26** to push collected materials through opening **28**.

[0039] As shown in FIGS. **2**, **3**, and **6**, system **10** may additionally or alternatively include a spray bar **58**. Spray bar **58** may be configured to further facilitate the removal of materials from mud tank **14**. For example, spray bar **58** may be configured to allow an operator spray out the inside of mud tank **14** without having to physically enter mud tank **14**. Spray bar **58** may be configured to direct water or other fluids to various surfaces of mud tank **14**. As shown, in some examples, spray bar **58** may be mounted on an upper portion of back wall **22** of mud tank **14**. In additional or alternative examples, spray bar **58** may be mounted at any other suitable location.

[0040] Spray bar **58** may be in fluid communication with a fluid entry port **60** through which an operator may introduce water or other fluids for passage through spray bar **58**. For example, an operator may connect a hose or spray wand to fluid entry port **60** to spray fluids through spray bar **58**. Additionally or alternatively, fluid entry port **60** may be in fluid communication with a water pump that an operator may selectively actuate to pump water through spray bar **58**.

[0041] Spray bar **58** may be configured to clean one or more internal surfaces of mud tank **14**. For example, as shown in FIG. **7**, which illustrates a detailed view of spray bar **58**, spray bar **58** may have a tubular configuration including a plurality of fluid exit ports **62** (or simply "exit ports **62**") through which fluid may be sprayed into the interior of mud tank **14**. Spray bar **58** may have any suitable number and/or configuration of exit ports **62** as may be desirable for a particular implementation. For example, spray bar **58** may have one or more exit ports **62** along the bottom of spray bar, one or more exit ports **62** along the front of spray bar **58**, one or more exit ports **62** along the top of spray bar **58**, and/or one or more exit ports **62** along the back of spray bar **58**. Each exit port **62** may have any suitable size and shape and/or may be configured to produce any desired size and shape of spray. In some examples, one or more exit ports **62** may have a rectangular shape and/or may be configured to produce a fan-shaped spray. In additional or alternative embodiments, one or more exit ports **62** may have any other suitable size and/or shape (e.g., circular, oval, square, angular, etc.).

[0042] Exit ports **62** may be directed in any suitable direction. For example, one or more exit ports **62** may be directed at one or more of side walls **18**, roof **20**, back wall **22**, end wall **24**, a floor **26**, blade **40**, and/or any other suitable portion of system **10** and/or mud tank **14**. In additional or alternative embodiments, spray bar **58** may include one or more diverter plates **64** configured to direct the stream of spray from exit ports **62** in any desired directions. Diverter plates **64** may be attached (e.g., welded, glued, etc.) to and/or extend from spray bar **58** at any suitable position and/or angled in any suitable direction. In some examples, spray bar **58** may include diverter plates **64** near some but not all of exit ports **62**. The inclusion, angle, and/or position of diverter plates **64** may be strategically varied in order to effectively spread the spray from spray bar **58** to different portions and/or surfaces of mud tank **14**. By so doing, spray bar **58** may successfully assist in cleaning the interior of mud tank **14**.

[0043] To illustrate the use of system **10**, once system **10** has been utilized to collect waste materials within mud tank **14**, an operator may open cover **30** and actuate blade **40** to push collected materials out of opening **28**. The operator may repeat this process by extending and retracting blade **40** as many times as necessary to push the collected materials out of opening **28**. Separate from or in conjunction with actuation of blade **40**, the operator may spray fluids through spray bar **58** to clean out any remaining materials adhering to the surfaces within mud tank **14**. The sprayed fluid and materials may then run and/or be pushed out of opening **28**.

[0044] In additional or alternative embodiments, system **10** may include any other features and/or devices to facilitate the removal of collected materials from mud tank **14**. For example only, system **10** may include one or more vibration units, one or more air cannons, and/or any other devices

configured to facilitate removal of build up to the surfaces of mud tank **14**. The internal surfaces of mud tank **14** may additionally or alternatively be coated and/or lined with one or more non-stick materials to help prevent material from adhering to the surfaces of mud tank **14**.

[0045] System **10** may be manufactured using any suitable materials connected in any suitable manner. For example, system **10** may be manufactured using one or more steel plates and/or steel cylinders welded or bolted together to form various parts of system **10**. In additional or alternative embodiments, system **10** may be manufactured using any other suitable materials (e.g., plastics, metals, rubbers, etc.) connected in any other suitable manner.

[0046] System **10** may be utilized in accordance with a vacuum truck. To illustrate, FIG. **8** shows an exemplary vacuum truck **100** including system **10** and manufactured according to the principles described herein. Vacuum truck **100** may be a hydrovac truck having a frame mounted on wheels. As shown in FIG. **8**, system **10** may then be mounted (e.g., bolted, welded, etc.) onto the frame of vacuum truck **100**. For clarity and to avoid unnecessarily complicating FIG. **8**, the components of system **10** are not labeled with their respective numerals in FIG. **8**, as such references can be found in FIGS. **1-7**.

[0047] Vacuum truck **100** may include any other devices and/or mechanisms (e.g., blowers, water pumps, hydraulic pumps, separators, silencers, filters, etc.) necessary or helpful for pneumatically collecting waste materials into system **10**. In some examples, vacuum truck **100** may include one or more power take offs ("PTOs") operably connected to vacuum truck **100** and configured to power one or more mechanisms of vacuum truck **100**. For example, vacuum truck **100** may include a blower that is powered by a PTO (e.g., a drive shaft) operably connected to the transmission and/or engine of the vacuum truck **100**.

[0048] An operator may utilize vacuum truck **100** to collect materials into tank **12**, and specifically into mud tank **14**. Once the materials have been collected and/or transported to a desired location, the operator may utilize the functionality of system **10** to remove or discharge the collected materials from vacuum truck **100** for processing or disposal. System **10** allows the operator to remove the collected materials from vacuum truck **100** without lifting the tanks of vacuum truck **100** and/or with minimal physical labor. Accordingly, the operator can more efficiently, effectively, and safely remove collected materials from vacuum truck **100**. Furthermore, because vacuum truck **100** may have fewer moving parts and components than conventional vacuum trucks, vacuum truck **100** may be more economical to build and maintain.

[0049] As mentioned above, the features and components of system **10** may be varied in any suitable manner as may be desired for a particular implementation. For example only, FIG. **9** illustrates an alternative system **10'** that may be similar in many respects to system **10** illustrated in FIGS. **1-8**. However, FIG. **9** shows one or more modifications that can be made to the system **10**. For example and not limitation, system **10'** includes a modified blade **40'**. As shown, blade **40'** may be similar in many respects to blade **40** discussed in more detail above. For example, blade **40'** may include an upper flange **42'**, a lower flange **44'**, and a guide slot **48'**. Additionally or alternatively, blade **40'** may include a back sweep or blade face **49'** (or simply "back face **49'**"). Back face **49'** may angle from the top of blade **40'** backwards and down to the surface of floor **26'**. In some examples, back face **49'** may be configured to facilitate the return of blade **40'** from an extended position to a retracted position. For example, back face **49'** may be configured to sweep away materials that have collected behind blade **40'** as blade **40'** returns to its retracted position. This may help prevent debris from getting lodged under blade **40'** and/or preventing blade **40'** from properly retracting. Back face **49'** may have any suitable angle and/or configuration to sweep away materials as blade **40'** retracts. Back face **49'** may additionally or alternative have one or more flanges to facilitate the sweeping of materials. System **10'** may have any other suitable modifications that may assist in the effective and safe removal of materials from within mud tank **14**.

[0050] One will appreciate that the systems and devices disclosed herein may be modified in a number of additional or alternative ways while remaining within the scope of this disclosure.

We claim:

1. A system for removing materials from a vacuum truck comprising:

a tank including a mud tank and a water tank, wherein the mud tank comprises:

one or more walls enclosing the mud tank,

an opening in the one or more walls of the mud tank to facilitate removal of materials from the mud tank,

a removable cover mounted on the mud tank and configured to selectively cover the opening in the mud tank, and

a floor extending between the one or more walls and having a downward slope towards the opening;

a blade positioned within the mud tank and configured to push materials on the floor of the mud tank towards the opening in the mud tank; and

a drive mechanism configured to selectively move the blade along the floor towards the opening in the mud tank; and

a guide rail extending along a length of the mud tank, wherein the guide rail is configured to guide movement of the blade.

2. The system of claim **1**, further comprising a spray bar within the mud tank, the spray bar comprising one or more fluid exit ports configured to direct fluid at one or more surfaces of the mud tank.

3. The system of claim **2**, wherein the spray bar further comprises one or more diverter plates configured to direct fluid from at least one of the one or more fluid exit ports towards one or more surfaces of the mud tank.

4. The system of claim **2**, wherein the spray bar is in fluid communication with a fluid entry port.

5. The system of claim **4**, wherein the fluid entry port is configured to receive fluid from at least one of a pump, a hose, and a spray wand.

6. They system of claim **1**, wherein the blade includes a back blade face configured to sweep away materials behind the blade as the blade retracts.

7. The system of claim **1**, wherein the floor has multiple distinct sections and is at least partially suspended above a floor of the water tank

8. The system of claim **7**, wherein the multiple distinct sections of the floor include a central section that slopes towards the opening in the mud tank and one or more side sections that angle inward towards the central section.

9. The system of claim **1**, wherein the guide rail extends along the floor of the mud tank.

10. The system of claim **9**, wherein the blade includes a guide slot configured to receive the guide rail and interact with the guide rail to restrict movement of the blade in one or more directions relative to the floor.

11. The system of claim **10**, wherein the interaction between the guide rail and the guide slot at least partially restricts sideways or upwards movement of the blade relative to a surface of the floor.

12. The system of claim **10**, wherein the guide slot and a cross-section of the guide rail are both T-shaped.

13. The system of claim **1**, wherein the drive mechanism is further configured to selectively retract the blade away from the opening.

14. The system of claim **1**, wherein the drive mechanism comprises one or more hydraulic cylinders.

15. The system of claim **14**, wherein the one or more hydraulic cylinders at least partially extend outside of the mud tank and into the water tank.

16. The system of claim **14**, wherein the one or more hydraulic cylinders are at least partially housed within one or more housings.

17. The system of claim **14**, wherein the one or more hydraulic cylinders are fixedly connected to the blade.

18. The system of claim **14**, wherein the path of movement of the blade is generally parallel to the orientation of the one or more hydraulic cylinders.

19. The system of claim **1**, wherein the one or more drive mechanisms comprises at least one of a belt drive mechanism, a chain drive mechanism, and a screw drive mechanism.

20. The system of claim **1**, wherein the one or more walls comprises one or more side walls, a back wall, and an end wall.

21. The system of claim **20**, wherein the opening is located within the end wall.

22. The system of claim **1**, wherein the blade has one or more flanges along a top, a bottom, or one or more sides of the blade.

23. The system of claim **22**, wherein the one or more flanges comprise a top flange and a bottom flange that angle towards the opening.

24. A system for removing materials from a vacuum truck comprising:

a tank for temporarily storing collected materials, the tank comprising:

one or more walls enclosing the tank,

an opening in the one or more walls of the tank to facilitate removal of materials from the tank,

a removable cover mounted on the tank and configured to selectively cover the opening in the tank, and

a floor extending between the one or more walls and having a downward slope towards the opening;

a blade positioned within the tank and configured to push materials on the floor of the tank towards the opening in the tank;

a drive mechanism configured to selectively move the blade along the floor towards the opening in the tank and retract the blade away from the opening; and

a spray bar within the tank, the spray bar comprising one or more fluid exit ports configured to direct fluid at one or more surfaces of the tank.

25. The system of claim **24**, further comprising a guide rail extending along the floor of the tank, the guide rail being configured to guide movement of the blade along the floor.

26. The system of claim **25**, further comprising a guide slot in the blade being configured to receive the guide rail and interact with the guide rail to restrict movement of the blade in one or more directions relative to the floor.

27. The system of claim **26**, wherein the interaction between the guide rail and the guide slot at least partially restricts sideways or upwards movement of the blade relative to a surface of the floor.

28. The system of claim **24**, wherein the spray bar further comprises one or more diverter plates configured to direct fluid from at least one of the one or more fluid exit ports towards one or more surfaces of the tank.

29. They system of claim **24**, wherein the blade includes a back blade face configured to sweep away materials behind the blade as the blade retracts.

30. A vacuum truck comprising:

a frame mounted on wheels;

a tank including a mud tank and a water tank, wherein the tank is mounted on the frame and wherein the mud tank comprises:

one or more walls enclosing the mud tank,

an opening in the one or more walls of the mud tank to facilitate removal of materials from the mud tank,

a removable cover mounted on the mud tank and configured to selectively cover the opening in the mud tank, and

a floor extending between the one or more walls and having a downward slope towards the opening, wherein the floor has multiple distinct sections and is at least partially suspended above a floor of the water tank;

a blade positioned within the mud tank and configured to push materials on the floor of the mud tank towards the opening in the mud tank;

a drive mechanism configured to selectively move the blade along the floor towards the opening in the mud tank; and

a guide rail extending along the floor of the mud tank, the guide rail being configured to guide movement of the blade along the floor of the mud tank.

31. The system of claim **30**, further comprising a spray bar within the mud tank, the spray bar comprising one or more fluid exit ports configured to direct fluid at one or more surfaces of the mud tank.

32. The system of claim **31**, wherein the spray bar further comprises one or more diverter plates configured to direct fluid from at least one of the one or more fluid exit ports towards one or more surfaces of the mud tank.

33. They system of claim **30**, wherein the blade includes a back blade face configured to sweep away materials behind the blade as the blade retracts.

34. The vacuum truck of claim **30**, further comprising a guide slot in the blade, wherein the guide slot is configured to receive the guide rail and interact with the guide rail to restrict movement of the blade in one or more directions relative to the floor of the mud tank.

35. The vacuum truck of claim **34**, wherein the interaction between the guide rail and the guide slot at least partially restricts sideways or upwards movement of the blade relative to a surface of the floor.

36. The vacuum truck of claim **30**, wherein the drive mechanism comprises one or more hydraulic cylinders that extend outside of the mud tank and at least partially into the water tank.

* * * * *